CHAPTE 2

SOLVING A BIOLOGICAL PROBLEM

MULTIPLE CHOICE QUESTIONS

1. **The freezing point of water:**
   (a) 10 °C (b) 0 °C (c) 5 °C (d) 15 °C
2. **The problem related to living organisms:**
   (a) Chemical (b) Geological (c) Biological (d) Physical
3. **Weight of one kilogram of water:**
   (a) 900 grams (b) 1000 grams (c) 800 grams (d) 700 grams
4. **Weight of one kilogram of ethanol:**
   (a) 879 grams (b) 789 grams (c) 987 grams (d) 768 grams
5. **Logical consequence drawn from hypothesis:**
   (a) Observation (b) Deduction (c) Experimentation (d) Result
6. **Malaria is derived from which language:**
   (a) German (b) Italian (c) French (d) Chinese
7. **When was America discovered?**
   (a) 16th century (b) 17th century (c) 18th century (d) 20th century
8. **Which disease has killed more people than any other disease?**
   (a) Cancer (b) AIDS (c) Tuberculosis (d) Malaria
9. **In which year A. F. A. King listed his 20 observations:**
   (a) 1881 (b) 1882 (c) 1883 (d) 1884
10. **When was *Plasmodium* discovered?**
    (a) 1876 (b) 1878 (c) 1880 (d) 1882
11. **Who discovered *Plasmodium*?**
    (a) Laveran (b) A. F. A. King (c) Ronald Ross (d) Darwin
12. ***Plasmodium* is the cause of malaria, is:**
    (a) Observation (b) Hypothesis (c) Deduction (d) Experiment
13. **A theory is supported by a great deal of:**
    (a) Evidence (b) Result (c) Experiment (d) Observation
14. **The information such as names, dates or values made from observations and experimentation:**
    (a) Data (b) Theory (c) Law (d) Observation
15. **Summarizing data through the calculation of a mean value:**
    (a) Mathematics (b) Statistics (c) Physics (d) Economics

ANSWERS:

1	b	2	c	3	b	4	b	5	b
6	b	7	b	8	d	9	c	10	b
11	a	12	b	13	a	14	a	15	b

SHORT QUESTIONS

Q. No. 1 Explain: "Man has always been a biologist."

MAN AS BIOLOGIST

A man has always been a biologist. He had to be a biologist in order to live. Early in history, he was hunter of animals and a gatherer of fruits, seeds, roots etc. The more he knew about animals and their habitat, the more successful hunter he was. The more he knew about plants, the better he distinguished between edible and non-edible plants.

Q. No. 2 Define Biological Problem.

BIOLOGICAL PROBLEM

A question related to living organisms that is either asked by some one or comes in biologist's mind by himself is called biological problem.

Q. No. 3 Define Biological Method.

BIOLOGICAL METHOD

The scientific method, in which biological problems are solved, is termed as Biological Method.

- It comprises the steps a biologist adopts in order to solve a biological problem.

Q. No. 4 How biological method has played an important part in scientific research?

IMPORTANCE OF BIOLOGICAL METHOD

- The biological method has played an instrumental role in scientific research for almost 500 years.
- From Galileo's experiment back in the 1590's to current research, the biological method has contributed to advancements in medicine, ecology, technology, etc.
- The biological method ensures the quality of data for public use.

Q. No. 5 Write steps of Biological Method in a sequence.

STEPS OF BIOLOGICAL METHOD

Biological method involves the following main steps:

- Recognition of a biological problem
- Observations
- Hypothesis formulation
- Deductions
- Experimentation
- Summarization of results (tables, graphics etc.)
- Reporting the results

Q. No. 6 What is the difference between qualitative and quantitative observations.

Qualitative Observations	Quantitative Observations
• Qualitative observations are not considered more accurate	• Quantitative observations are considered more accurate
• Qualitative observations are variable and less measurable.	• Quantitative one is invariable and measurable.
• These can not be recorded in terms of numbers.	• These can be recorded in terms of numbers.
Examples:	**Examples:**
• The freezing point of water is colder than its Boiling Point.	• The freezing point of water is 0 degree C and the boiling point is 100 degrees C.
• A liter of water is heavier than a liter of ethanol.	• A liter of water weighs 1000 grams and a Liter of ethanol weighs 789 grams.

Q. No. 7 How did Darwin formulate the theory of evolution?

FORMULATION OF THEORY OF EVOLUTION

Darwin not only observed and took notes during his voyage, but he also read the works of other naturalists to form his theory of Evolution.

Q. No. 8 Develop a deduction from the following hypothesis.
"All plant cells have a nucleus."

DEDUCTION

"If I examine cells from a blade of grass, then each one will have a nucleus."

Q. No. 9 What is control in an experiment?

CONTROL IN AN EXPERIMENT

In science, when doing an experiment, it must be a controlled experiment. A scientist must contrast an 'experimental group' with a 'control group'.

The two groups are treated exactly alike except for the one variable being tested.

For example; In an experiment to test the necessity for carbon dioxide during photosynthesis, one can contrast the control group (a plant with freely available carbon dioxide) with an experimental group (a plant with no carbon dioxide available). The necessity of carbon dioxide will be proved when photosynthesis occurs in the control group and does not occur in the experimental group.

Q. No. 10 Which was the only effective drug against malaria in earlier times?

DRUG AGAINST MALARIA

Quinine was the only effective remedy for malaria from 17^{th}-20^{th} century.

Q. No. 11 What is required for the maturation of eggs of female mosquito?

MATURATION OF EGGS OF FEMALE MOSQUITO

Female mosquitoes need blood of mammals or birds for the maturation of their eggs.

Q. No. 12 Why does female mosquito injects small amount of saliva into the wound?

INJECTION OF SALIVA INTO THE WOUND

When a female mosquito pierces the skin with her mouth parts, she injects a small amount of saliva into the wound before drawing blood. This saliva prevents the blood from clotting in the food canal.

Q. No. 13 Why do welts appear after mosquito bite?

APPEARANCE OF WELTS

The welts that appear after the mosquito leaves is not a reaction to the wound, but an allergic reaction to the saliva. In most cases, the itching sensation and swellings subside within several hours.

Q. No. 14 Define data.

DATA

"The information such as names, dates, or values made from observations and experimentation is called data."

Q. No. 15 In which formats data is organized?

DATA ORGANIZING FORMATS

Data is organized into different formats like

- Graphics
- Tables
- Flow-charts
- Maps
- Diagrams

Q. No. 16 How did physicians describe malaria in early days?

DESCRIPTION OF MALARIA

- The early physicians described malaria as a disease of chills and fevers with recurring attacks.
- They also observed that the disease was more common among people living in low, marshy areas.

Q. No. 17 What was the possible cause of malaria in early days?

POSSIBLE CAUSE OF MALARIA

The possible cause of malaria was thought that the stagnant water of marshes poisoned the air and as a result of breathing in this 'Bad Air', people got malaria.

Q. No. 18 From where the word malaria has been derived? What does it mean?

DERIVATION OF MALARIA & MEANING

The word malaria has been derived from **Italian** language that means:

- 'Mala' means 'bad'
- 'Aria' means 'air'

Q. No. 19 What was the treatment of malaria in early days:

MALARIAL TREATMENT

In the 17th century, when the New World (America) was discovered, many plants from America were sent back to Europe to be used as medicines. The bark of a tree known as 'quina-quina' was very suitable for curing fevers. It was so beneficial that it soon became impossible to carry enough bark to Europe. Some dishonest merchants began to substitute the bark of another tree, the 'cinchona' which closely resembled quina-quina.

This dishonesty proved much valuable for mankind. The cinchona bark was found to be excellent for treating malaria.

Q. No. 20 Why cinchona bark is effective in treating malaria?

EFFECTIVENESS OF CINCHONA BARK

The cinchona bark contains quinine which is effective in treating the disease.

Q. No. 21 Describe the discovery of *Plasmodium*.

DISCOVERY OF *PLASMODIUM*

Contribution of Laveran

In 1878, a French army physician Laveran began to search for the cause of malaria.

Experimental Work:

He took a small amount of blood from a malarial patient and examined it under a microscope. He noticed some tiny living creatures. His discovery was not believed by other scientists.

Confirmation:

Two years later, another physician saw the same creatures in the blood of another malarial patient.

Further Confirmation:

Three years later after this second discovery, the same creatures were observed for the third time.

Naming of Organism:

The organism was named '*Plasmodium*'.

Q. No. 22 In which major biological problems the knowledge of Mathematics is used?

USE OF MATHEMATICS IN BIOLOGICAL PROBLEMS

Major biological problems, in which knowledge of mathematics is used include:

- Gene finding
- Protein structure
- Protein-protein interactions

Q. No. 23 Define Bioinformatics.

BIOINFORMATICS

The use of the computational and statistical techniques for the analysis of biological data is called is called bioinformatrics.

LONG QUESTIONS

Q. No. 1 Describe the steps involved in biological method.

BIOLOGICAL METHOD

In solving a biological problem, biologist takes following steps:

1. Recognition of a biological problem
2. Observations
3. Hypothesis formulation
4. Deductions
5. Experimentation
6. Summarization of results
7. Reporting the results

1. **Recognition of a Biological Problem:**
   Biologists go for adopting a biological method when they encounter some biological problem.
   Biological Problem: A question related to living organisms that is either asked by some one or comes in biologist's mind by himself is called biological problem.
2. **Observations:**
   A biologist recalls his/her previous observations or makes new ones.
   Use of Senses:
   Observations are made with five senses of:
   - Vision
   - Hearing
   - Smell
   - Taste
   - Touch
3. **Formulation of Hypothesis:**

Observations do not become scientific observations until they are organized and related to a question. Biologist organizes his/her and others' observations into data form and constructs a statement that may prove to be the answer of the biological problem under study.

Definition:

A hypothesis is defined as:

'A tentative explanation of the observations is called as hypothesis'.

Or

'A proposition that might be true is called hypothesis.'

Characteristics of a good Hypothesis:

A good hypothesis should have the following characteristics:

- **General statement**: It should be a general statement
- **Tentative idea**: It should be a tentative idea.
- **Agreement with observations**: It should agree with available observations.
- **Simple**: It should be kept as simple as possible.
- **Falsifiable**: It should be testable and potentially falsifiable. In other words, there should be a way to show that the hypothesis is false, a way to disprove the hypothesis.

Use of Reasoning:

A great deal of careful and creative thinking is necessary for the formulation of a hypothesis. Biologists use reasoning to formulate a hypothesis.

4. **Deductions:**

Next, the biologist draws deductions from the hypothesis.

Definition

The logical consequences of a hypothesis are called deductions.

Formulation:

For formulating a deduction, a hypothesis is taken as true and expected results (deductions) are drawn from it.

Explanation

Generally, in a biological method, if a particular hypothesis is true, then one should expect deduction in a certain results. It involves the use of "if-then" logic.

5. **Experimentation:**

Basic Step:

The most basic step of a biological method is experimentation. A biologist performs experiments to see if hypotheses are true or not.

Testing of Deductions:

The deductions which are drawn from hypothesis are subjected to rigorous testing. Through experimentation, a biologist learns which hypothesis is correct.

Rejection or Acceptance of Hypothesis:

The incorrect hypotheses are rejected and the one which proves correct is accepted. An accepted hypothesis makes further predictions that provide an important way to further test its validity.

6. **Summarization Of Results:**

The biologist gathers actual, quantitative data from experiments.

Use of Statistical Analysis

Data for each of the groups are than averaged and compared statistically. To draw conclusions, a biologist also uses statistical analysis.

7. **Reporting The Results:**

Biologists publish their findings in scientific journals and books, in talks at international and international meetings and in seminars at colleges and universities.

Importance:

Publishing of results is an essential part of the scientific method. It allows other people to verify the results or apply the knowledge to solve other problems.

THEORY, LAW & PRINCIPLE

When a hypothesis is given repeated exposure to experimentation and is not falsified, it increases a biologist's confidence in hypothesis. Such a well-supported hypothesis may be used as the basis for formulating of further hypotheses which are again proved by experimental results.

THEORY

Definition:

"The hypothesis that stands the test of time (often tested and never rejected), is called a theory."

Support of Theory:

A theory is supported by a great deal of evidence.

Productive Theory:

A productive theory keeps on suggesting new hypotheses and so testing goes on.

Challenge for Biologists:

Many biologists take it as a challenge and exert greater efforts to disprove the theory.

LAW/PRINCIPLE

If a theory survives such doubtful approach and continues to be supported by experimental evidence, it becomes a 'Law' or 'Principle'.

- A scientific law is a uniform or constant fact of nature. It is an irrefutable theory.

Examples:

- Hardy-Weinberg Law
- Mendel's Laws of Inheritance
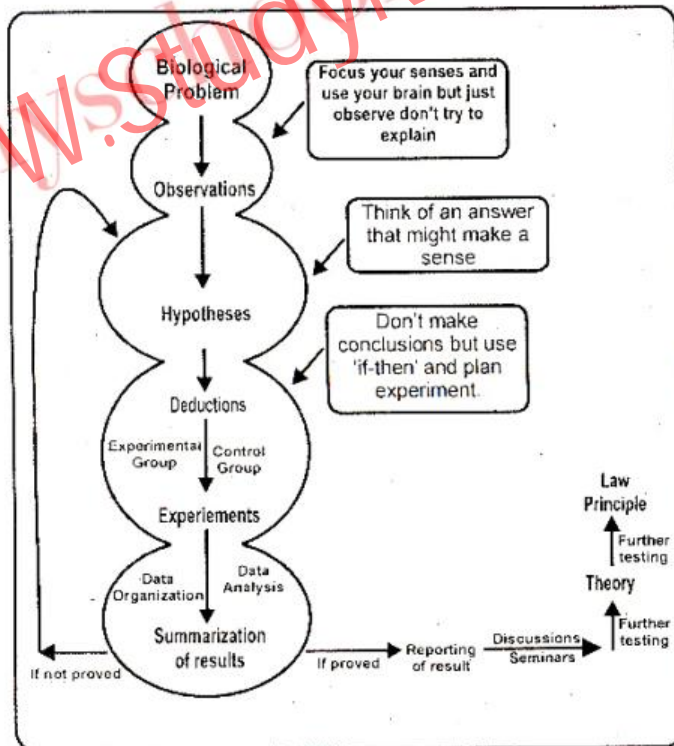
Figure: Biological Method

Q. No. 2 Describe the steps involved in biological method taking malaria as an example.

MALARIA AN EXAMPLE OF BIOLOGICAL METHOD

Introduction:

Malaria has killed more people than any other disease. The account of malaria is an example of a biological problem and of how such problems are solved.

Malaria is a common disease in many countries including Pakistan.

Observations about Malaria

In the last part of 19th century many different causes of malaria were being suggested. By that time there were four major observations about malaria.

- Malaria and marshy areas have some relation.
- Quinine is an effective drug for treating malaria.
- Drinking water from marshes does not cause malaria.
- 'Plasmodium' is seen in the blood of malarial patients.

Hypothesis Formulation:

A scientist uses whatever information and observation he has and makes one or more hypotheses. The hypothesis made in this case was:

'Plasmodium is the cause of malaria'.

Deductions

A scientist does not know whether this hypothesis is true or not, but he accepts that it may be true and makes deductions. One of the deductions from the above hypothesis was:

'If Plasmodium is the cause of malaria, then all persons ill with malaria should have Plasmodium in their blood'.

Experimentation:

The next step was to test the deduction through experiments which were designed as follows:

Experimental Group:

Blood of 100 malarial patients was examined under microscope.

Control Group:

Blood of 100 healthy persons was examined under the microscope.

Results:

The experimental results showed that almost all malarial patients had *Plasmodium* in their blood while 7 out of 100 healthy persons also had *Plasmodium* in their blood. *Plasmodium* in the blood of healthy individuals was in its incubation period i.e. the period between the entry of parasite in the host and appearance of symptoms.

Hypothesis Confirmation:

The results were quite convincing and proved that the hypothesis, '*Plasmodium is the cause of Malaria*' was true.

Further Research Work:

The next biological problem was to learn about '*How Plasmodium gets into the blood of a man?*'

Observations

Biologists were having the following observations:

- Malaria is associated with marshes.
- Drinking water of marshes does not cause malaria.

From these observations, it can be concluded that *Plasmodium* was not in the marsh water. It must be carried by something that comes to marsh water.

Observations of A.F.A King:

In 1883, a physician, A.F.A King, listed 20 observations:

Some of his important observations were:

- People who slept outdoors were more likely to get malaria than those who slept indoors.
- People who slept under fine nets were less likely to get malaria than those who did not use such nets.
- Individuals who slept near a smoky fire usually did not get malaria.

Hypothesis

On the basis of his observations, King suggested a hypothesis:

'Mosquitoes transmit Plasmodium and so are involved in the spread of malaria'.

Deductions

Following deductions were made considering the hypothesis as true.

'If mosquitoes are involved in the spread of malaria, then Plasmodium should be present in mosquitoes.'

'If mosquitoes are involved in the spread of malaria, then a mosquito can get Plasmodium by biting a malarial patient.'

EXPERIMENT OF RONALD ROSS

In order to test the above deductions, Ronald Ross, a British army physician working in India, in 1880's, performed important experiments.

Experiment 1:

- He allowed a female *Anopheles* mosquito to bite a malarial patient.
- He killed the mosquito some days later.
- On examining the mosquito, *Plasmodium* was found multiplying in mosquito's stomach.

Experiment 2:

The next logical experiment was to allow an infected mosquito (having *Plasmodium*) bite a healthy person.

Use of Sparrow:

If the hypothesis was true, the healthy person would have got malaria. But scientists avoid using human beings for experiments when results can be so serious. Ross used sparrows and redesigned his experiments.

Experiment:

- He allowed a female *Culex* mosquito to bite the sparrows suffering from malaria.
- Some of the mosquitoes were killed and studied at various times.
- Ross found that *Plasmodium* multiplied in the wall of mosquito's stomach and then moved into the mosquito's salivary glands.
- He kept some of the mosquitoes alive and allowed them to bite healthy sparrows.

Results:

Ross found that saliva of the infected mosquitoes contained *Plasmodia* and these entered sparrow's blood. When he examined the blood of these previously healthy sparrows, he found many *Plasmodia* in it.

EXPERIMENTATION ON MAN

In the end, the hypothesis was tested by direct experimentation on human beings. In 1898. Italian biologists took these steps for confirmation:

- They allowed an *Anopheles* mosquito to bite a malarial patient.
- The mosquito was kept for a few days
- Then it was allowed to bite a healthy man.

Results:

The person later became ill with malaria.

Confirmation of Hypothesis:

In this way it was confirmed that mosquitoes transmit *Plasmodium* and spread Malaria.
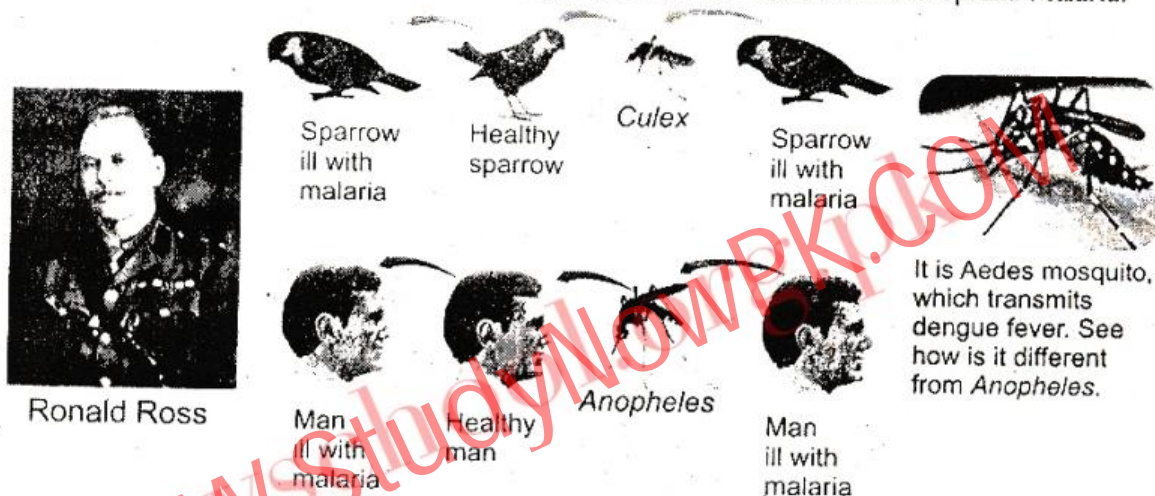
Figure: Malaria in sparrow and man is transmitted by Culex and Anopheles Mosquitoes Respectively

Q. No. 3 Write a note on data organization.

DATA ORGANIZATION

Definition:

The information such as names, dates, or values made from observations and experimentation is called data.

Collection of Data:

In order to formulate and then to test a hypothesis, scientists collect and organize data.

Data Collection Methods:

Prior to conducting an experiment, it is very important for a scientist to describe the data collection methods. It ensures the quality of the experiment.

Data Organizing Formats:

Data is organized into different formats like

- Graphics
- Tables
- Flow-charts
- Maps
- Diagrams

Q. No. 4 Write a note on Data Analysis.

DATA ANALYSIS

Data analysis is necessary to prove or disprove a hypothesis by experimentation.

Application of Statistical Methods:

Data analysis is done through application of statistical methods, i.e. ratio and proportion.

Ratio:

When a relation between two numbers e.g. 'a' and 'b' is expressed in terms of quotient (a/b) it is called the ratio of one number to the other.

Expression of a ratio:

A ratio is expressed by putting a division (÷) or colon (:) mark between two numbers.

Example:

The ratio between 50 malarial patients and 150 normal patients is 1:3.

Proportion:

Proportion means to join two equal ratios by the sign of equality (=)

Example:

a:b = c:d is a proportion between the two ratios. This proportion may also be expressed as a:b :: c:d

Calculation of Fourth Value:

When three values in a proportion are known, the fourth one (X) can be calculated.

Example:

A biologist can calculate how many birds will get malaria when he allows infected mosquitoes to bite 100 healthy sparrows. In the previous experiment he noted that when he allowed mosquitoes to bite 20 sparrows, 14 out of them got malaria. Now he may apply the proportion rule:

1st Ratio: 14:20 (14 out of 20)
2nd Ratio: X: 100 (How many out of 100)
Proportion: 14:20 :: X: 100

$$\frac{X}{100} = \frac{14}{20}$$

$$X \times 20 = 100 \times 14$$

$$X = \frac{100}{20} \times 14$$

$$X = 70$$

It means, 70 out of 100 sparrows would get malaria.

Importance of Statistics:

Statistics are thus a means of summarizing data through the calculation of a mean value. This step is very important as it transforms raw data into information, which can be used to summarize and report results.

Q. No. 5 Explain Mathematics as an integral part of scientific process.

MATHEMATICS AS AN INTEGRAL PART OF SCIENTIFIC PROCESS

Biological method involves the use of applied mathematics to solve biological problems.

Mathematical Applications:

Major biological problems, in which knowledge of mathematics is used include:

- Gene finding
- Protein structure
- Protein-protein interactions

Bioinformatics:

Bioinformatics refers to the computational and statistical techniques for the analysis of biological data.

REVIEW QUESTIONS

MULTIPLE CHOICE

1. **Which one of the following is a correct sequence in biological method?**
   (a) Observations, Hypothesis, Law, Theory
   (b) Hypothesis, Observations, Deduction, Experimentation
   (c) Observations, Hypothesis, Deduction, Experimentation
   (d) Law, Theory, Deduction, Observations
2. **Which one of these is NOT a characteristic of a hypothesis?**
   (a) Must be consistent with all available data
   (b) Must be testable
   (c) Must be correct
   (d) Must make predictions
3. **At which point is a biologist most likely to use reasoning?**
   (a) While taking observations
   (b) During hypothesis formulation
   (c) During data organization
   (d) None of the above
4. **A hypothesis must be testable to be scientifically valid. Being testable means that:**
   (a) Some observation could prove the hypothesis incorrect.
   (b) Only a controlled experiment can indicate whether the hypothesis is correct or incorrect.
   (c) The hypothesis is proven wrong
   (d) The opposite of hypothesis is tested and proven wrong
5. **What would be the best experimental design for testing a hypothesis that bean plants require sodium?**
   (a) Measure the amount of sodium in a few bean plants
   (b) Grow bean plants with and without sodium
   (c) Look for sodium in leaf tissues
   (d) Analyze root contents for sodium
6. **A gardener sees a large snake nearby. He knows that generally snakes sting, so the gardener ran away. The gardener did which of the following?**
   (a) Used reasoning
   (b) Used observation
   (c) Constructed a theory
   (d) Tested a hypothesis
7. **A scientific theory has which of the following properties?**
   (a) It agrees with available evidence
   (b) It cannot be rejected
   (c) It has been absolutely proven
   (d) It does not need to be altered in the light of new evidence
8. **Experimentation is only a step of scientific process, but it is a very important because it always:**
   (a) Gives the biologist a correct result
   (b) Allows rejection of some alternative hypotheses
   (c) Ensures that hypotheses can be confirmed with certainty
   (d) Gives scientists a chance to work in the laboratory

9. **You are testing a hypothesis: 'Students learn more if they drink tea before sitting for study'. Your 20 experimental students drink tea before study; you test their learning by giving questions. Your 20 students of the control group should have all experimental conditions identical to the experimental group except that:**
(a) They should take tea with more milk and sugar
(b) They should take tea before as well as during study
(c) They should not take tea before study
(d) After taking tea, they should not sit for study.

ANSWER:

1	c	2	c	3	b	4	b	5	b
6	b	7	a	8	b	9	c		

UNDERSTANDING THE CONCEPTS

(1) Describe the steps involved in biological method taking malaria as an example.

Consult Long Question # 2

(2) If a test shows that some people have *Plasmodium* in their blood but they do not show any symptoms of malaria, what hypothesis would you formulate to answer this problem?

FORMULATION OF HYPOTHESIS

The hypothesis can be formulated as:

'There is a specific time period between entry of Plasmodium in an individual's blood and appearance of malarial symptoms.'

Plasmodium is an infectious parasitic organism. Upon entry in an individual's body, it undergoes an 'Incubation period' of 7-10 days. Incubation period is the time period between entry of parasite in the host and the appearance of symptoms. During this period, *Plasmodium* multiplies in the liver. When a sample of blood is checked for the presence of *Plasmodium* during this period, the patient is apparently healthy and free-of-disease, but *Plasmodium* is detected in the blood.

(3) How are the principles of ratio and proportion used in the biological method?

USE OF PRINCIPLES OF RATIO AND PROPORTION IN BIOLOGICAL METHOD

Statistical principles of ratio and proportion are frequently used in the biological method for data analysis.

Ratio:

When a relation between two numbers e.g. 'a' and 'b' is expressed in terms of quotient (a/b) such a relationship is the ratio of one number to the other.

Expression of a ratio:

A ratio is expressed by putting a division (÷) or colon (:) mark between two numbers.

Example: The ratio between 50 malarial patients and 150 normal patients is 1:3.

Proportion:

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Example: a:b = c:d is a proportion between the two ratios. This proportion may also be expressed as a:b :: c:d

(4) Justify mathematics as an integral part of the scientific process.

Consult Long Question # 5

SHORT QUESTIONS

(1) Differentiate between theory and law.

Theory	Law
• A theory is a confirmed hypothesis, which stands the test of time and evidence.	• A law is an irrefutable theory, which is a constant fact of nature and is never rejected
• A theory is a challenge for disproval.	• A law is never a challenge for disproval.
• A theory can be altered in case of new evidence.	• A law is already an established and definite entity. It cannot be altered.
• A theory is always subjected to new testing	• A law is not subjected to further testing.
Example: Mosquitoes transmit malaria	**Example:** Hardy-Weinberg Law

(2) Quantitative observations are better in biological method. How?

BETTERMENT OF QUANTITATIVE OBSERVATIONS

In quantitative kind of observation, the descriptions are given in the form of numbers and values. Hence they are better than qualitative observations in the following aspects:

- Specific
- Accurate
- Measurable
- Invariable
- Provide better information

For example:

The boiling point of water is 100 °C. This statement gives us a straight and specific piece of information based on a definite value.

TERMS TO KNOW

Bioinformatics: It refers to the use of computational and statistical techniques for the analysis of biological data.

Biological method: A specialized method used to solve a particular biological problem and find solution to specific questions asked regarding that problem

Biological problem: A query about life that is either asked by someone or comes to a biologist's mind.

Control group: The scientific study group which is constant, i.e. without the effect of a variable.

Deduction: Logical consequences of a hypothesis.

Experiment: A specific scientific procedure to determine or test something.

Experimental group: The scientific study group, on which a variable is acting.

Hypothesis: A tentative explanation of observations.

Law: An irrefutable theory; a constant fact of nature.

Observation: The act of noticing or perceiving something.

Theory: The accepted hypothesis that stands the test of time.